The Formulation of a Meatless Pepperoni Product Utilizing Dairy Ingredients.

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Abstract

Many consumers want variety in their protein choices and are looking at alternative protein sources like dairy and plant proteins to substitute for meat in typical meat-based products, but do not want to sacrifice flavor. The objective was to formulate a meatless pepperoni product with dairy ingredients that will not lack in flavor or texture for the consumer. Butter was adjusted using various food ingredients to produce a fat base similar to pork fat. This was tested using a makeshift capillary melting point method, using a water bath and test tubes, to measure the change in melting point and compare the melting point to pork fat. Pepperoni prototypes were constructed using textured soy protein, acid whey, an appropriate pepperoni spice profile, citric acid, and the formulated butter mixtures and were baked for drying purposes. These prototypes were tested using a texture analyzer, water activity meter, and pH meter, and were compared to the target of a store-bought meat-based pepperoni. The texture of the formulated pepperoni product was adjusted looking at the gelling properties of isolated whey protein, albumin, and a mixture of casein and whey. The melting point of butter when compared to pork fat was extremely low, and butter lacked the fibrous structure and protein that pork fat has. The adjustments made to the butter raised melting point closer to the rendering point for pork fat and created a fibrous structure for the butter to hold the fat, like pork fat. By adding common food industry binders and proteins, the firmness of the pepperoni product improved to be able to be processed properly and gained the ability to be sliced. The addition of dairy ingredients into meatless products creates further opportunities for the agricultural industry to utilize more resources, expand into many different markets, and offer a variety of products for consumers.

Key Words: Dairy, Proteins, Meatless products, Butter, Alternative Meats

Introduction.

The trend of meatless products and plant-based protein is on the rise worldwide and is now moving more from a niche consumer base to more of a mainstream base (Curtain and Grafenauer, 2019). The number is products on the market has increased significantly since 2015 and the trend does not seem to be slowing down, but instead speeding up (Curtain and Grafenauer, 2019). These new

plant-based products however when looking at the micronutrients makeup sometimes fall short of some nutrients such as Calcium, Vitamin D, Zinc, Vitamin B12, and Iron (Curtain and Grafenauer, 2019) (Craig, 2010). The Addition of dairy ingredients into these plant-based products could help raise the amount of these nutrients in the plant-based products because dairy ingredients are high in many of these micronutrients, such as Calcium, Zinc, and Vitamin B12 (Górska-Warsewicz, Rejman, Laskowski, & Czeczotko, 2019). The replacement of many meat-based ingredients in meatless products however can be quite a task as the structures can be very different. Pork fat or pork adipose tissue is a loose connective tissue that contains various connective tissues holding the fat together that butter and dairy ingredients lack. This feature, however, helps hold the structure of pork fat and leaves some solid fat after rendering. Modifying and utilizing many different ingredients is necessary for replacing meat in meatless products, without sacrificing product functionality and flavor. The objectives of this research were to modify butter to make a replacement for pork fat in a pepperoni product, and to formulate a pepperoni that is vegetarian.

Materials and Methods

Butter Sample Preparation

Butter (Giant Eagle, Pittsburgh, PA), was melted so that the butter liquified, but the milk solids and the butter did not separate. A different component was added to the liquified butter and was thoroughly incorporated with an emulsifying hand blender (Hamilton Beach, Glen Allen, VA), for 20 seconds. This procedure was repeated with every different butter sample. The samples were formulated to test by percentage based on weight of the sample. All samples made were 25g samples. The different samples were 1%,2%,5%, and 10% Beeswax (Sky Organics, Delray Beach, FL), 1%,2%,5%, and 10% LM Pectin (Modernist Pantry, Portsmouth, NH.), a combination of 1% sodium Alginate (Fisher Scientific, Waltham, MA) and ranging concentrations of 0%, 0.5%, 1%, and 1.5% Calcium Chloride (Fisher Scientific,

Waltham, MA), and to test the synergistic effects of Locust bean gum(Fisher Scientific, Waltham, MA) and Xanthan gum(Fisher Scientific, Waltham, MA), combinations of the two gums were tested: Sample 1: 0.5%of both gums, Sample 2: 0.75% of both gums, Sample 3: 0.25% locust bean gum and 75% Xanthan Gum, Sample 4: 1% of each gum, Sample 5: 1.5% Locust Bean Gum, and 5% Xanthan Gum, Sample 6: 0.5% locust bean gum, and 1.5% xanthan gum, and finally Sample 7: 1.5% of each gum in the formulation.

Melting point determination– Makeshift Capillary Method

A beaker was filled a quarter of the way with cold water and placed on a hot plate. Two grams of each sample was placed into a 10-ml test tube and placed into the cold-water bath. A pork fat control and regular butter control was included in every test. The hot plate was turned on and each sample was monitored. The temperature of each sample was taken by an Infrared Thermometer (Food Safety Infrared (IRFS), Thermoworks, Salt Lake City, Utah.) when the butter mixture began to liquify and when the butter was completely melted to get a melting range for each sample. The ranges were then compared to the controls to evaluate the melting characteristics.

Pepperoni Formulation

Different pepperoni Recipes were analyzed to create a realistic pepperoni spice profile and develop a procedure to create the meatless pepperoni (Filippone,2020)[4] (2020)[5]. Commercial texturized soy (Whole Foods, Austin, TX) was used as the base of the product and the best butter mixture constructed above was used as the fat base. The textured soy was rehydrated using a mixture of dairy ingredients and water using a ratio of one-part soy to two-parts watered dairy mixture. The new butter component was then cut into small pieces using a kitchen knife and added to the newly rehydrated soy mixture, and citric acid was added to lower the pH and give acidic flavor. The mixture was extruded using a Kitchen-Aid mixer (Kitchen-aid, Benton Harbor, MI), and attachment and was extruded into 23-

millimeter vegan meat casings (Sausagemaker, Buffalo, NY). These sausages were baked in a convection oven a 3:25 for 2.5 hours, and chilled overnight before testing the firmness of the product. Different formulations of the product where analyzed from adding egg whites (Giant eagle, Pittsburgh, PA) at 5% , and Vital Wheat Gluten (Bob's Red Mill, Milwaukie, OR) at 5%, and other various ingredients.

Texture analysis

The texture of the finished pepperoni prototypes were tested using a texturometer (TA.TX.PLUS, Scanco, San José, Guachipelin, Costa Rica), and performed a cut test on the different pepperoni samples. The pepperoni prototype samples firmness data was compared to an industry control sample pepperoni (Giant Eagle, Pittsburgh, PA)

Results and Discussion

The different butter samples and temperature melting ranges were compared to each other and to the pork and butter samples present at every test. When looking at the results in figure 1 you can see that the butter mixtures when compared to the pork fat control, almost none of the samples had a high enough melting range to compete with the standard pork fat. The only butter mixture samples that contained the melting range like the pork fat was with the addition of the Beeswax at both 5% and 10% (Figure 1). This could be because beeswax has a similar melting point to the rendering of pork fat and when it comes to waxes has one of the highest melting points (Lan,2019).

The butter mixtures focusing in the addition of fibrous mixtures (locust bean and xanthan gum, pectin, and sodium alginate solution) increased the melting range when compared to the regular butter sample but did not come close to the pork fat to be a useful replacement to pork fat. These samples however did contain something that the beeswax samples lacked. After they melted, they have a fibrous precipitate that separated from the liquified butter. Looking into how to trap the butter into the fibrous casings could increase the functionality of the butter to be useful and raise the melting temperature as

some of the fat would be trapped in the fiber and gums, like the pork fat. When baking, some of the butter leaked out onto the baking trays as well. More work needs to be done to trap the fat in a makeshift tissue like substance, to help hold the liquified fat into the pepperoni to make for a better-quality product.

Figure 3: Results of the Capillary Melting Test.

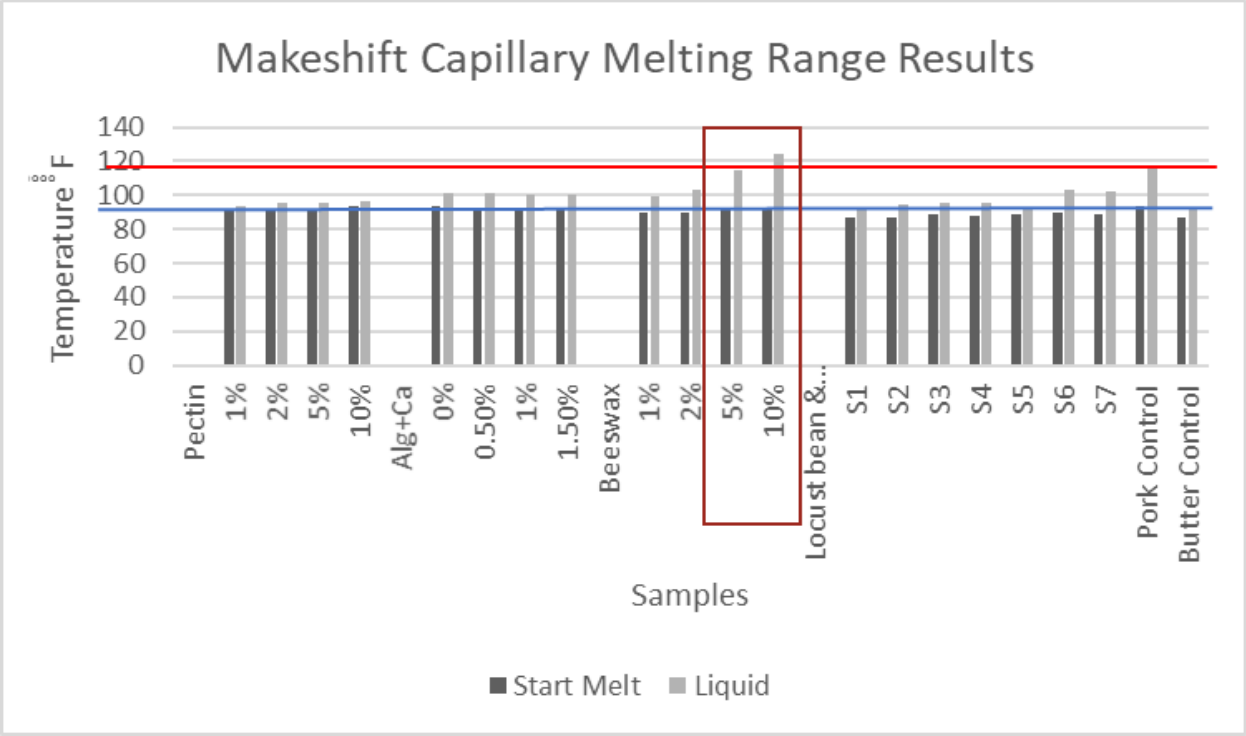
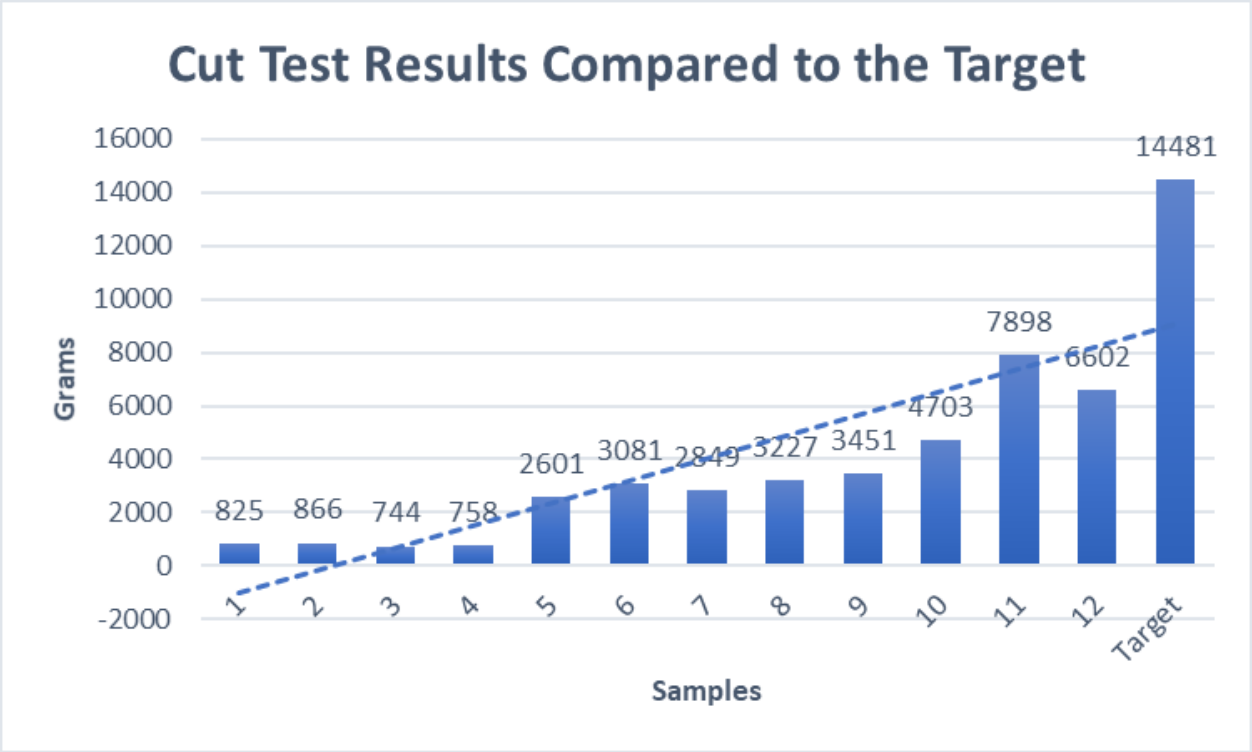


Figure 2 below shows the results from the cut test on the pepperoni prototypes. The results show the force (grams) needed to cut through the pepperoni logs, with the knife attachment. When looking at the data from the firmness test you can see that the addition of food additives did help affect the firmness of the product, however none of the samples formulated came close to the firmness of the pepperoni control sample. The commercial pepperoni firmness needed 14,481 grams of force to cut through it and the closest sample, sample 7 is the closest firmness requiring 7898 grams, but is barely half of the firmness that the commercial sample is. The samples were created in sets of 4, (1-4, 5-8, 9-12) and the trends indicate that the firmness with each new formulation was getting closer to the target

pepperoni samples. The pepperoni also needed to be formulated to be better put together, the pepperoni was very hard to slice and crumbled under pressure. To be a marketable product more formulation would be needed to fix the issue of a crumbling product and more processing and formulating is needed to be done to make this a sellable product.

Figure 2: Results of a Cut Force test to test hardness



Conclusion

The meatless trend has not only grown in the past few years but is continuing to grow at a rapid rate. The use of dairy ingredients can be used to enhance these products and still be able to keep them vegetarian. Butter can be used as a fat source for the use in meatless products with a little more research. The formulation of a meatless pepperoni is also a promising product.

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